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Model 2450 / 2490 / 2495

**E N V I R O N M E N T
C O N T R O L L E R**

Version 1.0

℞Ⓤ

UL Recognized

Bellcore
Approved

APPLICABILITY & EFFECTIVITY

Effective for all Model 2450 systems manufactured after July 1, 1996.

Instruction Manual Part Number T10014

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1.   Product Description

1.1.   General

The Model 2450 Environment Controller provides electronic, microprocessor-based sensing and control of heating, ventilation and air conditioning (HVAC) and other environmental conditions in remote telecommunications structures including various huts, cabinets and vaults. Specialized software is used to collect data from sensor inputs and make continuous, real time, control and alarm logic decisions. The results of the logic are used to operate control outputs, send alarms to telephone company systems, and display alarm conditions on the front panel of the controller.

1.2.   Special Features

A unique aspect of the Model 2450 is that environmental sensors, required for most telephone company applications, are integrated into the controller design. These sensors include temperature, humidity, combustible gas, carbon monoxide, oxygen and hydrogen sulfide. The design also provides for easy direct connection of additional temperature and humidity sensors as components, eliminating the need for expensive external signal conditioning electronics. Power supply and alarm input connections provide a standard smoke detector interface. Spare industry

Figure 1-1
Model 2450 Environment Controller

standard 4-20 mA inputs allow for other sensors to be added without mechanical retrofit of the controller.

There are three assemblies required for installation of the environment controller. These include the Model 2450 Environment Controller, a Model 2490 Interface Module, and a Model 2495 Alarm Connection Module. Figure 1-2 provides a logic block diagram of the three components. Various configurations of each model are denoted by a two digit suffix to the base model number.

1.3.   Factory Configuration

Model 2450 controllers are supplied with factory default setpoints which match specific applications. Setpoints can be changed via a computer interface.

1.4. Computer Interface

Model 2450 controllers are designed for convenient external interface via either direct or modem personal computer (PC) connection or via a hand held terminal. (See Section 7) The controller automatically recognizes the method of communication at the time of any connection:

- Computer: The controller recognizes that the calling device is a computer operating in terminal mode and returns a menu onto the screen of the terminal. When the computer operator selects an alpha character corresponding to a menu choice, a sub-menu or data form is returned by the controller. This method of communication avoids the need for use of a specific software package for which the operator would require training.

- Hand Held Terminal: A specially configured hand held terminal can be used to process inquiries by pressing labeled keys on the terminal. Response by the controller is similar to the response to a computer.

Figure 1-2
Environment Controller Interface Block Diagram
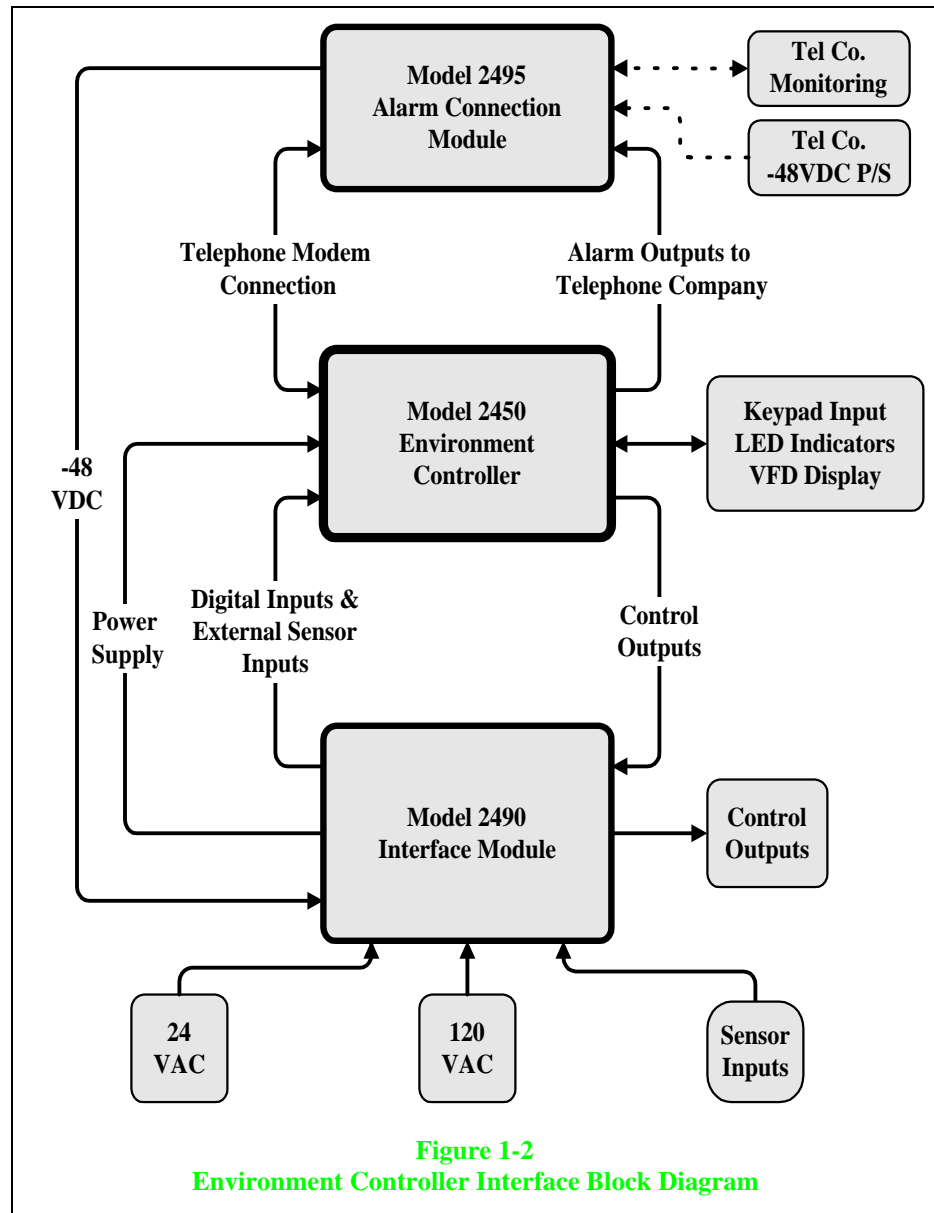
1.5. Power Requirements

Model 2450 controllers operate from a 5 VDC power supply located on the Model 2490 Interface Module.

Model 2490 Interface Modules contain the following power supplies:

- Primary Power: 110 VAC input, +5 VDC output—for primary controller power

- Secondary Power: -48 VDC input, +5 VDC output—for back-up controller power. This supply will be automatically switched into use when 110 VAC Primary power is lost. The -48 VDC input is protected against over-voltage to -66 VDC. It is recommended that the -48 VDC secondary power source be current limited to 1.0 Amp maximum.
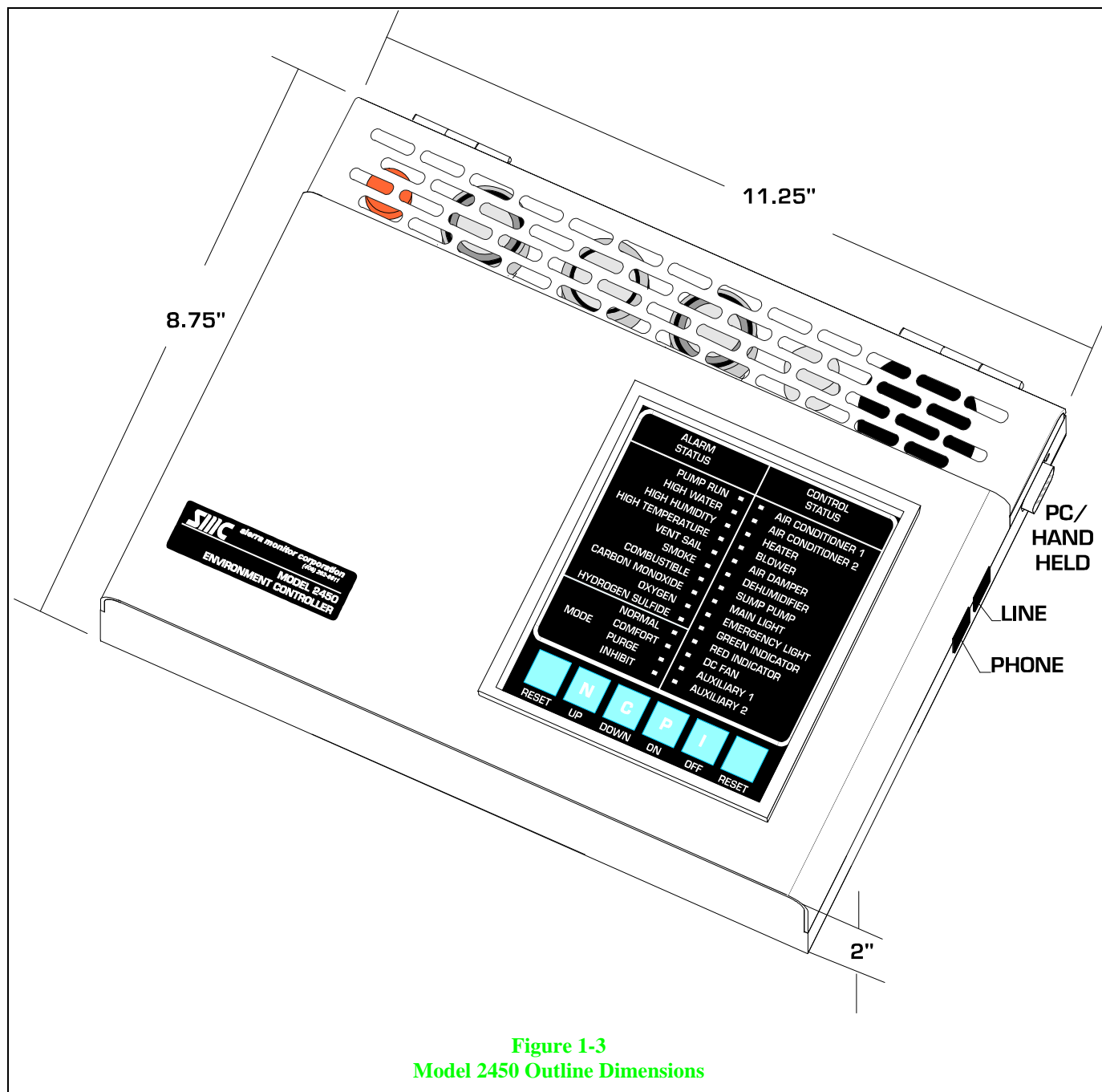
Figure 1-3
Model 2450 Outline Dimensions
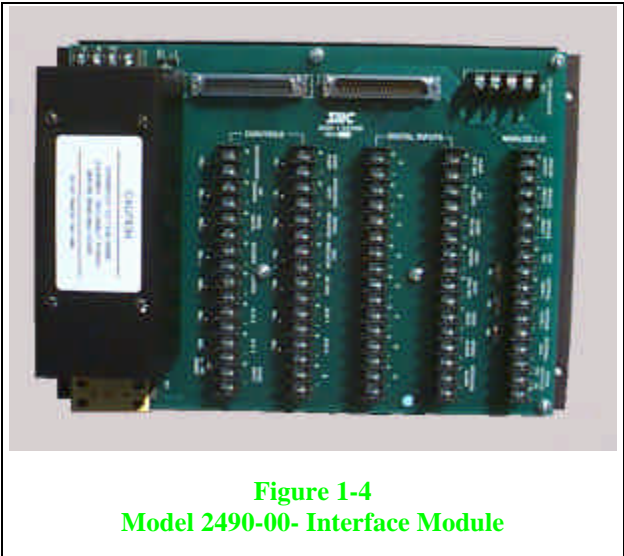
Figure 1-4
Model 2490-00- Interface Module
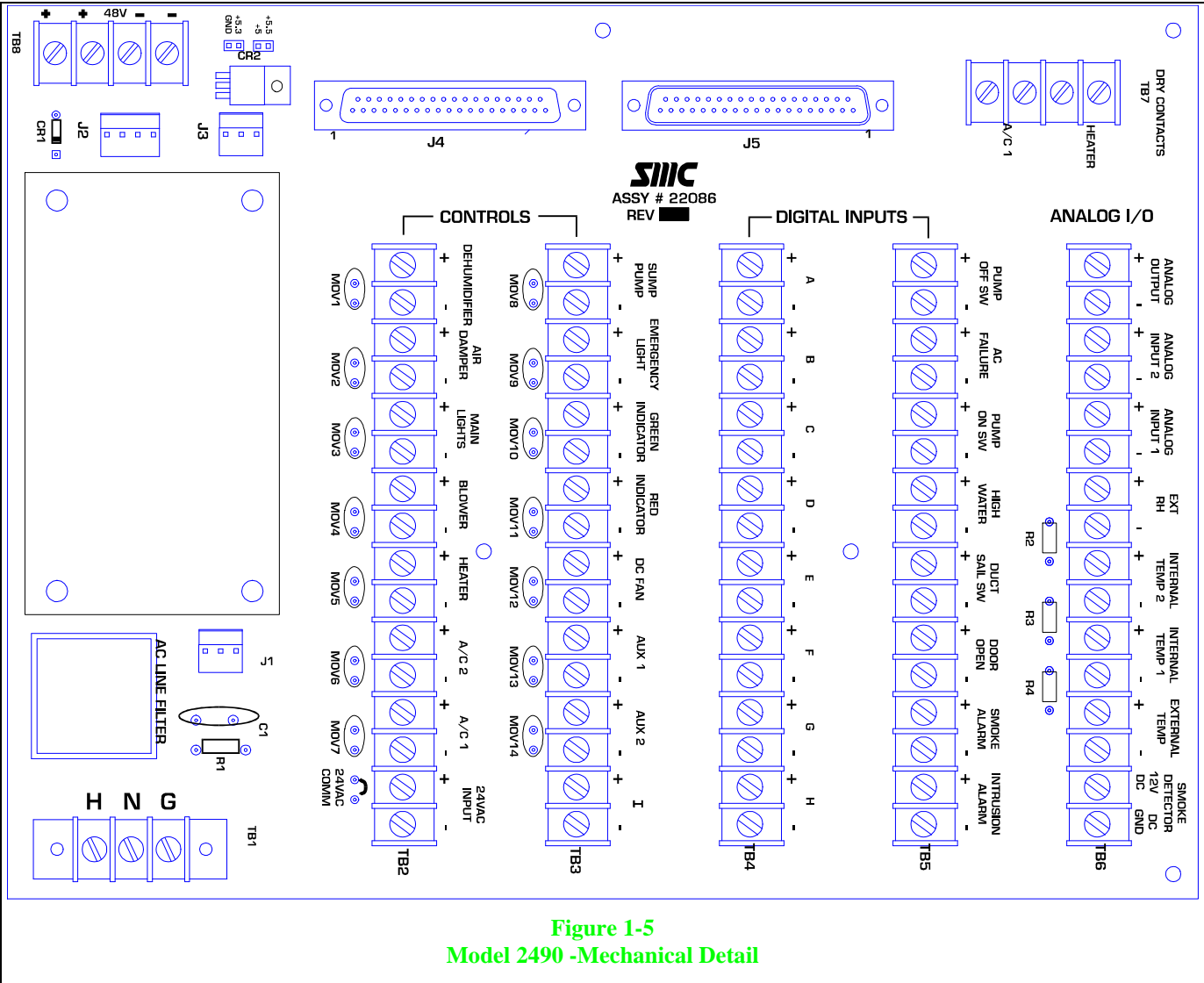
Figure 1-5
Model 2490 -Mechanical Detail

Figure 1-6
Model 2495 - Mechanical Details
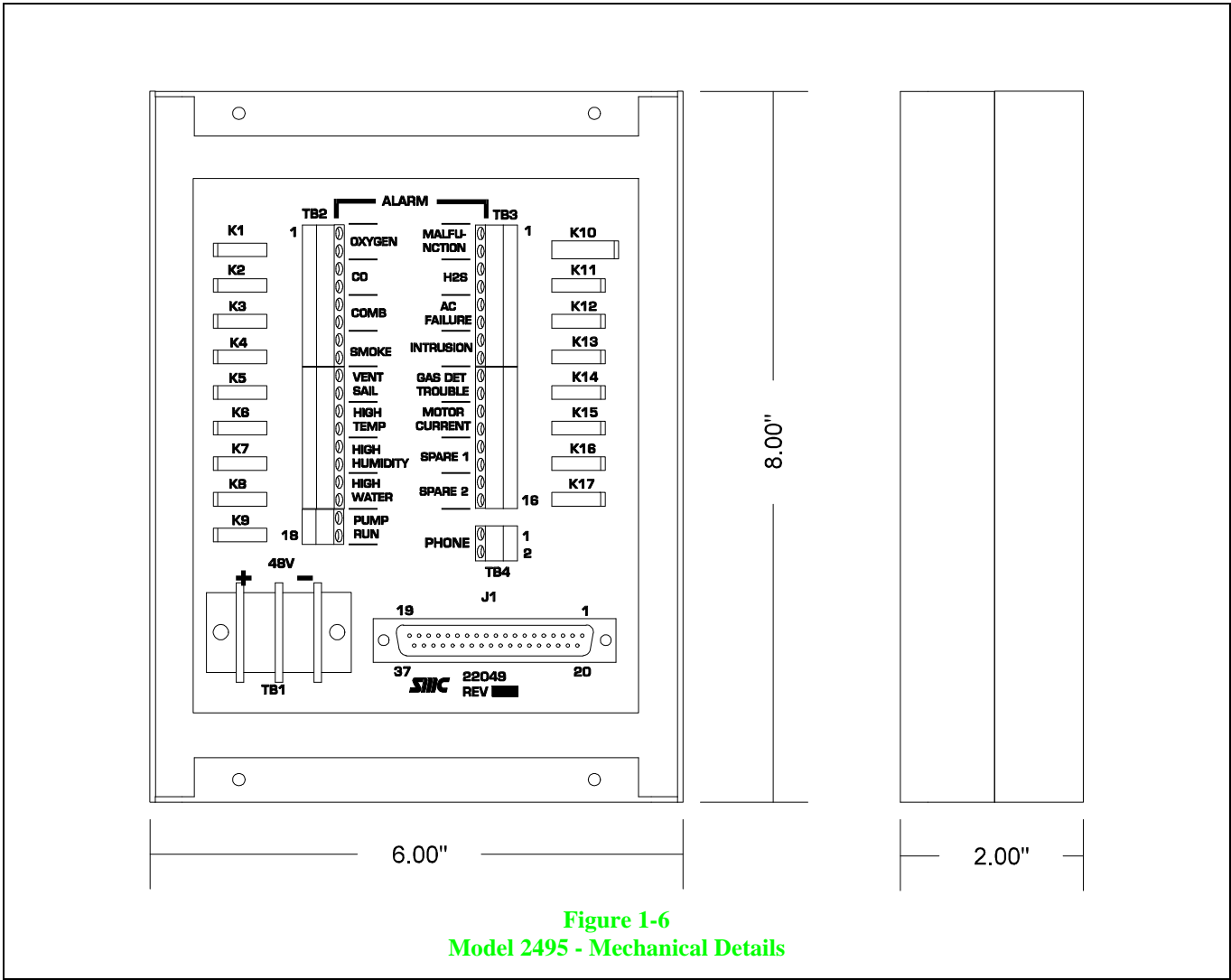
2.   Cautions and Warnings

2.1.   Introduction

The Environment Controller is designed and constructed for installation on a vertical surface in a structure which provides protection from "hostile" environments such as rain or excessive dust. Caution should be taken to insure that the installation is made in compliance with this instruction manual and any applicable electrical codes.

2.2.   Controller

Install the controller in a location which will insure that the gas, temperature and humidity sensors are exposed to the ambient environments and are not blocked from air flow or diffusion. The gas, temperature and humidity sensors are installed under the slotted cover at the top of the controller. Do not tightly surround the controller with other equipment which might limit exposure to ambient air, temperatures and gases.

The only devices which are to be connected to the controller are ribbon cables supplied by Sierra Monitor with matching "D" connectors. The only sensors to be installed in the gas sensor sockets are sensors supplied by Sierra Monitor for use in Environment Controllers.

2.3.   Wiring

Wiring connections to the Interface Module must be in accordance with National Electric Code and wires must be sized based on the maximum calculated load.

2.4.   External Sensors and Actuators

External temperature and humidity sensors connected to the Interface Module must be supplied by, or approved by, Sierra Monitor. All other external sensors and actuators are the responsibility of the installer.

2.5.   Operator Cautions

Do not enter the structure if a local alarm (red light and/or audible alarm) is on. Follow established, prescribed procedures until the alarm condition is removed.

If an alarm occurs while you are inside a structure follow established, prescribed procedures or immediately evacuate the structure until an authorized person determines that it is safe to return to the structure.

2.6.   Secondary Power Source for Model 2490

The -48 VDC secondary power source for Model 2490 Interface Modules must be current limited to 1.0 Amp maximum. Do not connect the system to a DC power source that does not meet this requirement.

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3.   Installation

</div>

3.1.   Component Mounting

The following sections provide instructions for installation of each of the three major components of the environment controller.   Installation and wiring of all components and interface devices must be made in accordance with National Electrical Code.

3.1.1.   Controller (2450)

Installation location of the controller is determined by the structure design: The controller can be installed on the outside of the door of the control cabinet which is generally situated beside or below the electrical distribution cabinet.

The Controller is attached to the door of the control cabinet by four threaded studs located on the back of the controller. In addition to the holes for the mounting studs, slots are required to be cut on the door to provide access to three interface connectors and one grounding stud on the back face of the controller. The grounding stud on the controller must be connected to earth ground.

Figure 3.1 provides details for the mounting holes and the access slot. A full size drilling template can be obtained from Sierra Monitor.

Figure 3-1
Mounting Details
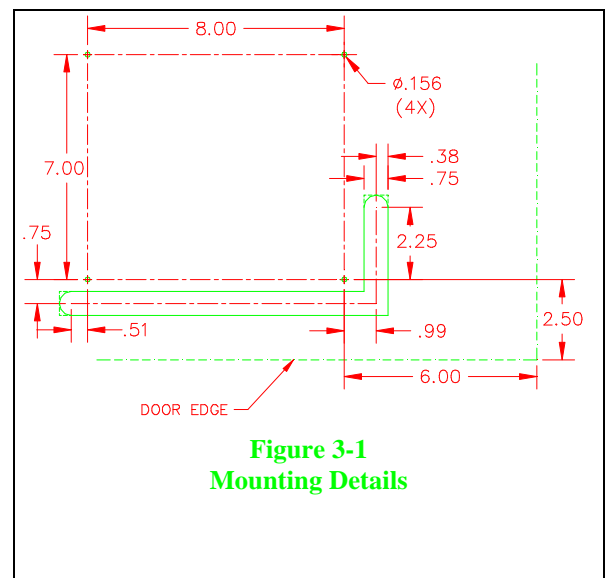
3.1.2.   Interface Module (2490)

The interface module should be installed inside the control cabinet in a manner which allows separation of low voltage and high voltage wiring. Due to the routing of ribbon cables between the interface module and the controller it is recommended that the interface module be installed in the left side of the cabinet closest to the hinged door.

The interface module is supplied mounted on a carrier plate which has four holes for screw mounting to the control panel plate.

3.1.3.   Alarm Connection Module (2495)

The Alarm Connection Module is generally installed immediately above, or to the right of the control cabinet. Select a location which allows easy access by telephone company installers who will connect the alarm outputs, phone line and DC power. The installer will need to make conduit hub knock-outs in the enclosure to match installation requirements. Conduits must be 3/4" minimum to allow cable connector feed through. (See Figure 1-6).

3.2.   Ribbon Cables

All connections between the Controller, Interface Module and Alarm Connection Module are by ribbon cable supplied with the original equipment.

3.2.1.   Controller

Two ribbon cables, supplied with the Model 2450 Controller provide all the required interconnections to the Model 2490 Interface Module. The cables are correctly sized and their connectors are gendered so that they cannot be misconnected.

Install the two 37-conductor cables between the back of the 2450 and the two corresponding connectors on the 2490 interface board. (See Figure 3-2).

3.2.2.   Alarm Connection Module

One ribbon cable, supplied with the Model 2495 Alarm Connector Module, provides all the required interconnections to the Model 2450 Controller.

Connect the 37 conductor cable to the vertical "D" connector on the back of the 2450 and feed the other end into the Alarm Connection Module for connection into the "D" connector on the PCB assembly.

Note that only one incoming phone line can be connected to the modem. This can be via, either, the phone jack on the side of the Controller, or the two position telephone connector on the Alarm Connection Panel.
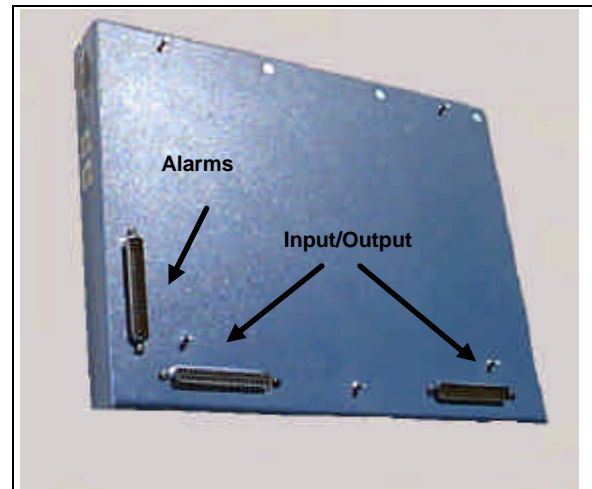
Figure 3-2
Ribbon Cable Connectors
Rear View of Model 2495

3.3.   Customer Wiring

3.3.1.   Interface Module

Figures 3-3 through 3-5 provide details of the use of each of the wiring terminals on the Interface Module. Specific user configurations and control requirements will dictate which of the wiring positions will be used for each application.

3.3.2.   Alarm Connection Module

Figure 3-6 provides details of the use of each of the wiring terminals on the Alarm Connection Module. Specific user configurations and control requirements will dictate which of the alarms should be connected by the telephone company.

3.4.   Power up

Install and inspect all interface wiring and controlled devices prior to power up of the controller.

The controller can be powered up by either the 110 VAC supply or the -48 VDC supply, or both, in either order.

When power is turned on the controller will perform a 5-minute warm-up, during which none of the inputs will be processed and no alarm will be generated. To indicate that the warm-up is in progress the alarm indicator lights on the front panel will turn on and off in a vertical (walk) sequence.

After initial power up, manual or automatic tests can be performed to insure that each of the controlled devices is functioning. These tests are described in the operation section of the manual.

When the controller has not been in operation for an extended period, such as storage before installation, the real time clock will be incorrect. It is generally not necessary to reset the clock until the structure is placed into full time operation. A computer terminal or hand held terminal is required to set the clock.

3.5.   Power Down

All user-configured parameters and collected history data is saved in non-volatile EEPROM memory. No data will be lost due to a power interruption or extended power outage. If it is necessary to power down the controller, remove both AC and DC power sources.

Controls
TB2, TB3

24 VAC Neutral

①	Dehumidifier
②	
③	Air Damper
④	
⑤	Main Lights
⑥	
⑦	Blower
⑧	
⑨	Heater
⑩	
⑪	A/C 2
⑫	
⑬	A/C 1
⑭	
⑮	24 VAC Source
⑯	
⑰	Sump Pump
⑱	
⑲	Emergency Lights
⑳	
㉑	Green Indicator
㉒	
㉓	Red Indicator
㉔	
㉕	DC Fan
㉖	
㉗	Auxiliary 1
㉘	
㉙	Auxiliary 2
㉚	
㉛	Digital Input I
㉜	

- - - - - - - - - - - - - - - **FIELD WIRING**

———————— **INTERNAL**

Connector Legend		
#	**Connector**	**Marking**
1	TB2	Dehumidifier +
2	TB2	Dehumidifier -
3	TB2	Air Damper +
4	TB2	Air Damper -
5	TB2	Main Lights +
6	TB2	Main Lights -
7	TB2	Blower +
8	TB2	Blower -
9	TB2	Heater +
10	TB2	Heater -
11	TB2	A/C 2 +
12	TB2	A/C 2 -
13	TB2	A/C 1 +
14	TB2	A/C 1 -
15	TB2	24 VAC Input +
16	TB2	24 VAC Input -
17	TB3	Sump Pump +
18	TB3	Sump Pump -
19	TB3	Emergency Lights +
20	TB3	Emergency Lights -
21	TB3	Green Indicator +
22	TB3	Green Indicator -
23	TB3	Red Indicator +
24	TB3	Red Indicator -
25	TB3	DC Fan +
26	TB3	DC Fan -
27	TB3	Aux 1 +
28	TB3	Aux 1 -
29	TB3	Aux 2 +
30	TB3	Aux 2 -
31	TB3	(Digital Input) I +
32	TB3	(Digital Input) I -

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Model 2490
Interface Module
Controls Wiring Connections

Figure 3-3
Wiring Connections - Controls

Digital Inputs
TB4, TB5

#	Connector	Marking
1	TB4	Digital Input A +
2	TB4	Digital Input A -
3	TB4	Digital Input B +
4	TB4	Digital Input B -
5	TB4	Digital Input C +
6	TB4	Digital Input C -
7	TB4	Digital Input D +
8	TB4	Digital Input D -
9	TB4	Digital Input E +
10	TB4	Digital Input E -
11	TB4	Digital Input F +
12	TB4	Digital Input F -
13	TB4	Digital Input G +
14	TB4	Digital Input G -
15	TB4	Digital Input H +
16	TB4	Digital Input H -
17	TB5	Pump Off Sw. +
18	TB5	Pump Off Sw. -
19	TB5	AC Failure +
20	TB5	AC Failure -
21	TB5	Pump On Sw. +
22	TB5	Pump On Sw. -
23	TB5	High Water +
24	TB5	High Water -
25	TB5	Duct Sail Sw. +
26	TB5	Duct Sail Sw. -
27	TB5	Door Open +
28	TB5	Door Open -
29	TB5	Smoke Alarm +
30	TB5	Smoke Alarm -
31	TB5	Intrusion Alarm +
32	TB5	Intrusion Alarm -

Connector Legend

Digital Input A
Digital Input B
Digital Input C
Digital Input D
Digital Input E
Digital Input F
Digital Input G
Digital Input H
Pump Off Switch
AC Failure
Pump On Switch
High Water
Duct Sail
Door Open
Smoke alarm
Intrusion Alarm

FIELD WIRING

INTERNAL

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Model 2490
Interface Module
Digital Input Wiring Connections

Figure 3-4
Wiring Connections - Digital Inputs

Analog I/O
TB-6

1	+	Analog Output
2	-	
3	+	Analog Input 2
4	-	
5	+	Analog Input 1
6	-	
7	+	External RH Sensor
8	-	
9	+	Internal Temp. 2
10	-	
11	+	Internal Temp. 1
12	-	
13	+	External Temp.
14	-	
15	+ VDC	Smoke Detector 12 VDC
16	Comm.	
17		Heater
18		
19		A/C 1
20		

Connector Legend

#	Connector	Marking
1	TB6	Analog Output +
2	TB6	Analog Output -
3	TB6	Analaog Input 2 +
4	TB6	Analog Input 2 -
5	TB6	Analog Input 1 +
6	TB6	Analog Input 1 -
7	TB6	External RH +
8	TB6	External RH -
9	TB6	Internal Temp. 2 +
10	TB6	Internal Temp. 2 -
11	TB6	Internal Temp. 1 +
12	TB6	Internal Temp. 1 -
13	TB6	External Temp. +
14	TB6	External Temp. -
15	TB6	Smoke Det. +12 VDC
16	TB6	Smoke Det. DC Gnd
17	TB7	Heater
18	TB7	Heater
19	TB7	A/C 1
20	TB7	A/C 1
21	TB8	48V +
22	TB8	48V +
23	TB8	48V -
24	TB8	48V -

Tel/ Co. Power
TB-8

48 VDC +	1	- 48 VDC Source
48 VDC +	2	
Comm	3	
Comm	4	-48 VDC

Main Power
TB-1

Hot	1	H
Neutral	2	N 110 VAC Source
Ground	3	G

---- FIELD WIRING

──── INTERNAL

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Model 2490
Interface Module
Analog I/O Wiring Connections

Figure 3-5
Wiring Connections - Analog I/O

Telco Connections

Oxygen Alarm — 1, 2

CO Alarm — 3, 4

Combustible Alarm — 5, 6

Smoke Alarm — 7, 8

Vent Sail Alarm — 9, 10

High Temp. Alarm — 11, 12

High Humidity Alarm — 13, 14

High Water Alarm — 15, 16

Pump Run Alarm — 17, 18

Malfunction Alarm — 19, 20

H2S Alarm — 21, 22

AC Failure Alarm — 23, 24

Intrusion Alarm — 25, 26

Gas Det. Trouble — 27, 28

Motor Current Alarm — 29, 30

Spare Alarm 1 — 31, 32

Spare Alarm 2 — 33, 34

Phone — 35, 36

48 VDC Pass Through — 37, 38

FIELD WIRING ----------   INTERNAL ————

#	Connector	Marking
1	TB2	Oxygen
2	TB2	Oxygen
3	TB2	CO
4	TB2	CO
5	TB2	Comb
6	TB2	Comb
7	TB2	Smoke
8	TB2	Smoke
9	TB2	Vent Sail
10	TB2	Vent Sail
11	TB2	High Temp
12	TB2	High Temp
13	TB2	High Humidity
14	TB2	High Humidity
15	TB2	High Water
16	TB2	High Water
17	TB2	Pump Run
18	TB2	Pump Run
19	TB2	Malfunction
20	TB3	Malfunciton
21	TB3	H2S
22	TB3	H2S
23	TB3	AC failure
24	TB3	AC Failure
25	TB3	Intrusion
26	TB3	Intrusion
27	TB3	Gas Det Trouble
28	TB3	Gas Det Trouble
29	TB3	Motor Current
30	TB3	Motor Current
31	TB3	Spare 1
32	TB3	Spare 1
33	TB3	Spare 2
34	TB3	Spare 2
35	TB4	Phone 1
36	TB4	Phone 2
37	TB1	48 VDC +
38	TB1	48 VDC -

Connector Legend

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Model 2495
Alarm Connection Module
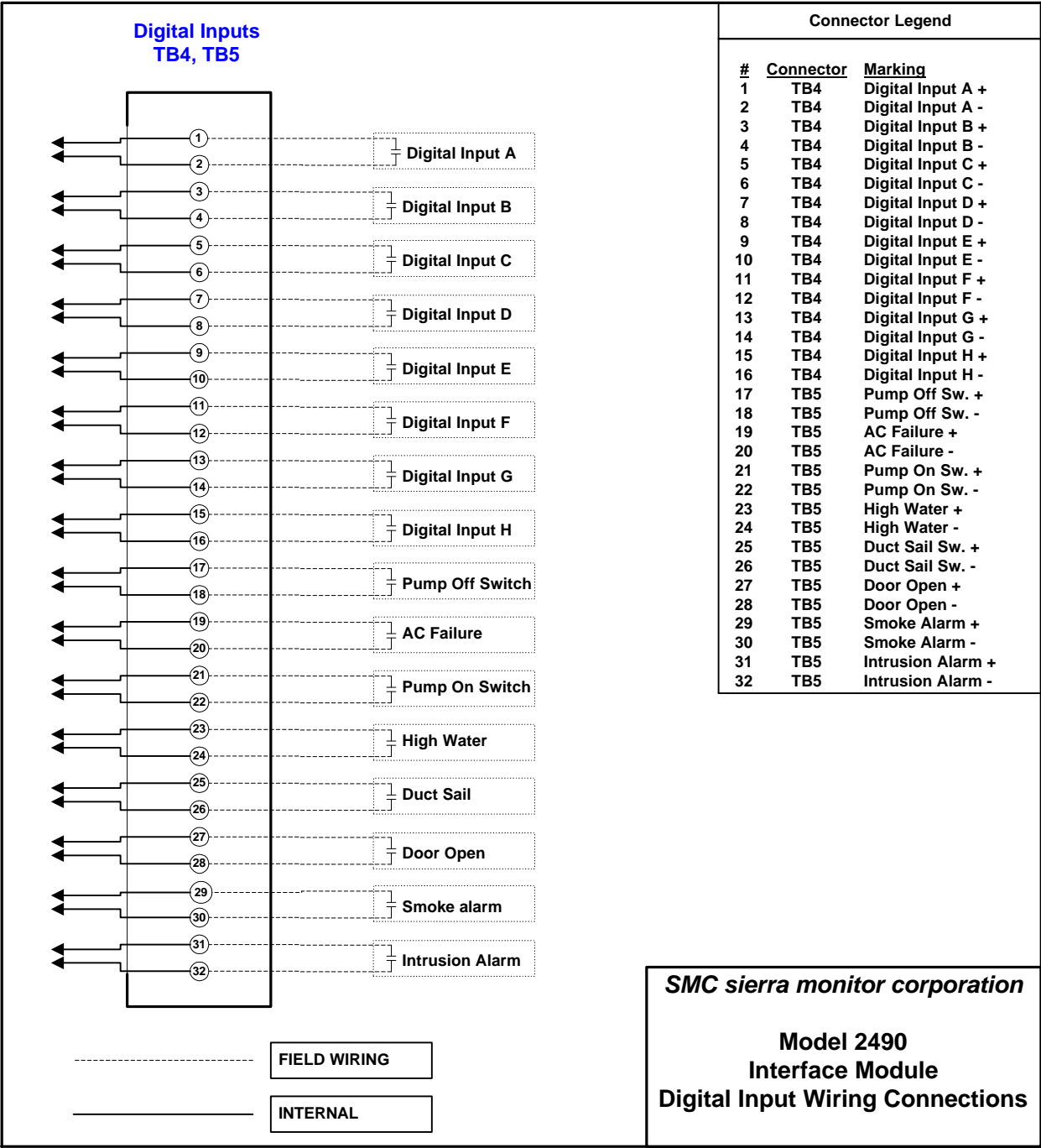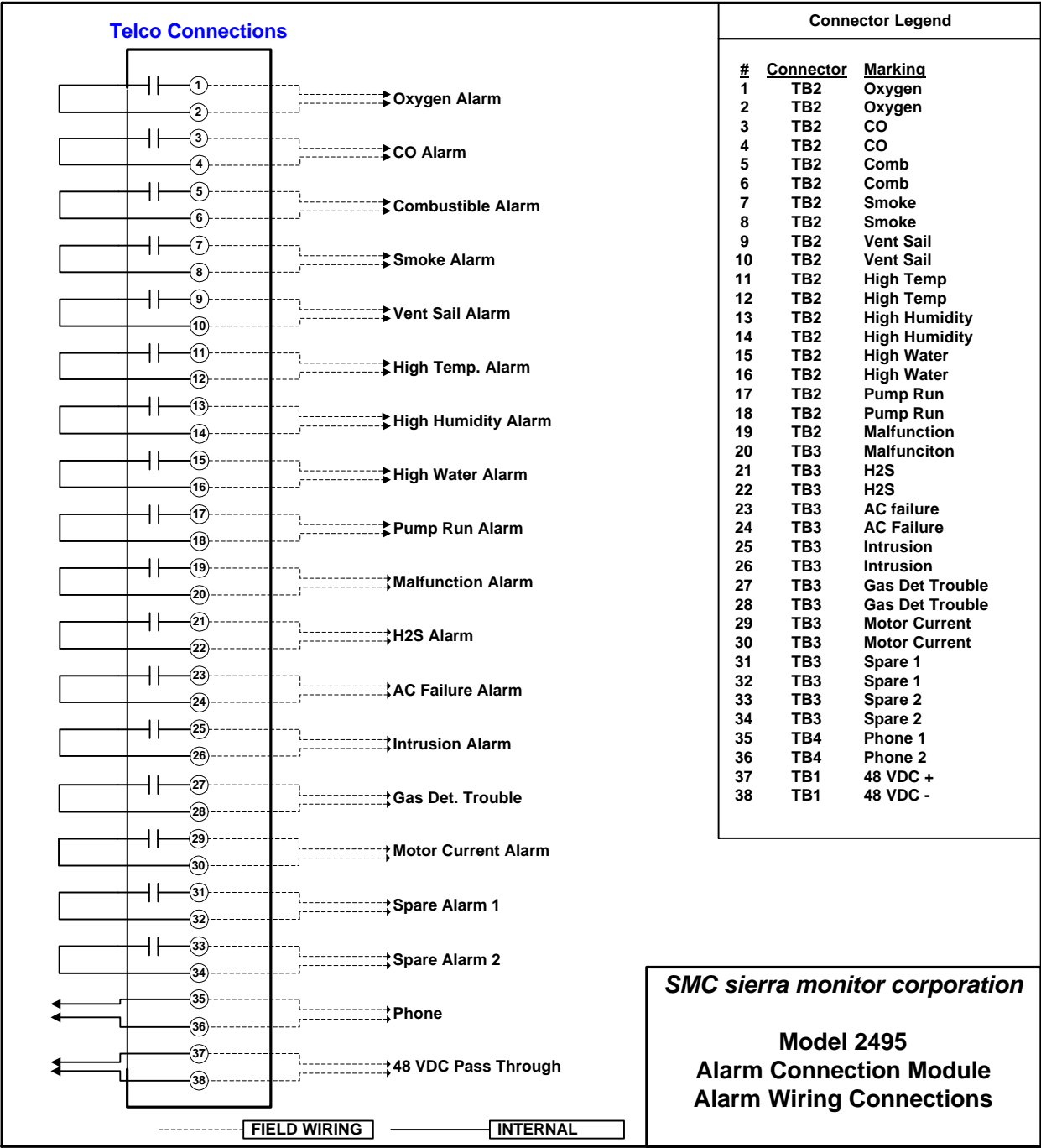**Alarm Wiring Connections**

Figure 3-6
Wiring Connections - Alarm Connection Module

4.   Operation

4.1.   Introduction

The Model 2450 provides continuous automatic control of environmental conditions within the structure and initiates alarms when abnormal conditions cannot be corrected. The controller automatically tightens limits when the structure is occupied and returns to wider limits when the structure is not occupied.   Under normal circumstances, the only operator action required is to press a key to confirm that the structure is occupied.

The front panel (Figure 4-1) contains a display area and a keypad. The display has 28 LED indicators for mode, alarm and control status, and the keypad contains 6 push-button key switches. The function and use of the indicators and key switches are described in the following sections.

4.1.1.   Indicators

The LED indicators are separated into three functional blocks:

- Run Mode (4 LEDs). Only one Run Mode can be active at any time, so only one Mode LED will normally be on, and the other three will be off.

- Control Status (14 LEDs). Various combinations of control devices may be active at any time based on the environmental control logic and the occupied status of the structure.

- Alarm status (10 LEDs). Any combination of alarm conditions may exist, but generally, no alarms should be present if the structure controls are operating correctly.

The LED indicators also provide feedback to the operator during other special operations, such as during calibration or test. During testing, the 14 control device indicators retain their normal functions, while the remaining LEDs are used to show which of the control devices is selected for test. During calibration, the four gas alarm indicators have special functions to indicate the status of the calibration process.

4.1.2.   Controls

The six push-button control keys include two reset keys on either end of the row and four function keys. The reset keys are spaced to either side of the panel to avoid accidental resetting of the controller. When it is necessary to reset, both keys must be pressed at the same time.

There are two labels for each of the four function keys. The primary labels (N, C, P, I) correspond to the NORMAL, COMFORT, PURGE, and INHIBIT Run Modes, respectively. The secondary labels (UP, DOWN, ON, OFF) correspond to key functions during TEST.

Table 4-1 provides an overview of operator key press sequences. In this manual "Press" a key means a momentary activation of the key. "Hold" a key means depress and hold the key for five seconds, then release. Whenever it is necessary to "Hold" a key, a change in visual status will indicate that the key has been held long enough.

In one case, activation of test modes, it is necessary to press a key within 2 seconds after a previous key press. In all other key press or hold steps, there is no minimum time requirement between operator actions.

ALARM STATUS	CONTROL STATUS
PUMP RUN ☐	☐ AIR CONDITIONER 1
HIGH WATER ☐	☐ AIR CONDITIONER 2
HIGH HUMIDITY ☐	☐ HEATER
HIGH TEMPERATURE ☐	☐ BLOWER
VENT SAIL ☐	☐ AIR DAMPER
SMOKE ☐	☐ DEHUMIDIFIER
COMBUSTIBLE ☐	☐ SUMP PUMP
CARBON MONOXIDE ☐	☐ MAIN LIGHTS
OXYGEN ☐	☐ EMERGENCY LIGHT
HYDROGEN SULFIDE ☐	☐ GREEN INDICATOR
NORMAL ☐	☐ RED INDICATOR
COMFORT ☐	☐ DC FAN
MODE PURGE ☐	☐ AUXILIARY 1
INHIBIT ☐	☐ AUXILIARY 2

►	N	C	P	I	◄
RESET	UP	DOWN	ON	OFF	RESET

**Figure 4-1
Model 2450 Control Keys**

4.2.   Modes of Operation

There are four modes of operation; **RUN, VIEW, TEST** and **SENSOR MAINTENANCE**. For most modes there are sub modes. In this manual modes and sub modes are identified by unique bold capital letters. Table 4-1 lists the modes, sub modes, and the primary control key presses to enter each mode.

When the structure is not occupied it automatically reverts to **NORMAL** operation.

When the structure is occupied, any of the modes of operation can be manually selected. When any of the run modes are active, the corresponding mode LED will flash slowly.   **COMFORT** is automatically initiated when the structure is occupied unless this feature is turned off by changing set points.

MODE	SUB-MODE	CONTROL KEY
RUN	NORMAL	Press N.
	COMFORT	Press C
	PURGE	Press P.
	INHIBIT	Press I.
VIEW	VIEW	Hold N.
TEST	MANUAL	Reset, then Press **UP**
	AUTOMATIC	Reset then Press **OFF**
SENSOR MAINTENANCE	CALIBRATE	In **COMFORT,** Hold C
	MAP	In **CALIBRATE,** Hold C

**Table 4-1
Modes and Control Keys**

Special key entry combinations to activate **VIEW**, **TEST** and **SENSOR MAINTENANCE** are discussed in further detail in this chapter. There are various timer states and special functions, including calibration delays, sensor warm-up, sensor failure and sensor mapping, that are be mentioned where appropriate.

4.2.1.   Run Mode

4.2.1.1.   Normal

The default mode of operation, which is automatically initiated when the structure is unoccupied, is **NORMAL**.

In **NORMAL**, the lights are off, the maximum and minimum temperatures are extended to save energy by reducing heating or air conditioning demands, gas alarm levels are increased to facility protection levels, and sump pump and dehumidifier functions are active. Any of the following conditions activate **NORMAL**:

- The controller has been reset and the warm-up timer has cleared.

- The N key is pressed, when the controller is in one of the run modes.

- **PURGE, INHIBIT, COMFORT** or **CALIBRATE** have timed out.

4.2.1.2.   Comfort

The typical mode of operation when a structure is occupied is **COMFORT**.   **COMFORT** is automatically activated when the door has been opened and the structure is safe for entry.

In **COMFORT**, the lights are on, the maximum and minimum temperatures are contracted to provide heating or air conditioning comfort for occupants, the gas alarm levels are tightened to personnel protection levels, and sump pump and dehumidifier functions are active. **COMFORT** is activated when:
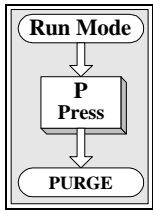

- The structure door is opened.
- The C key is pressed momentarily.

Conditions or actions which usually cause the controller to exit **COMFORT** are:

- A different mode key is pressed.

- The structure's door is closed and no function key is pressed within six minutes.

- Two hours have elapsed since **COMFORT** was initiated.

4.2.1.3.   Purge
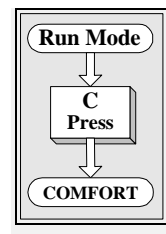
Run Mode
↓
**P
Press**
↓
PURGE

PURGE is used to force ventilate structures which use static damper control. **PURGE** is automatically activated when the structure door is first opened. **PURGE** can also be initiated by pressing the P key when the controller is in another run mode.

In **PURGE**, all HVAC, sump pump, and dehumidifier logic functions are active and the blower is always on. All temperature set points retain their **NORMAL** or **COMFORT** settings based on the mode immediately preceding activation of **PURGE**.

PURGE times out, but can be stopped by pressing any other key.

- In structures using static damper control, **PURGE** opens the damper and runs the blower for five minutes. (Note that **PURGE** will not run if there is a smoke alarm.)

- In structures using dynamic damper control, **PURGE** opens the damper to maximum, continues the constant blower operation and activates the DC fan if it is installed.

4.2.1.4.   Inhibit

INHIBIT can be used by a craftsperson to turn off the HVAC equipment to quiet the structure for a short period of time. In this mode, all blower, air conditioner, sump pump and dehumidifier activity is inhibited for five minutes. To start **INHIBIT**, press the I key.

Run Mode
↓
**I
Press**
↓
INHIBIT

INHIBIT can be interrupted after it has been started by pressing any other function key. **INHIBIT** can be activated only when it is safe to turn off all the control devices. **INHIBIT** will be terminated and the controller will return to **NORMAL** if any alarm occurs.
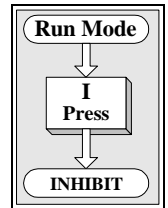
4.2.2.   View Mode
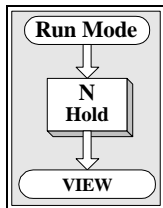
Run Mode
↓
**N
Hold**
↓
VIEW

Controllers with the optional Vacuum Fluorescent Display (VFD) continuously show the temperature and humidity when the structure is occupied and the controller is in one of the Run Modes. When the exit procedure is in progress a warning message is displayed to prompt an operator to press a key to keep the lights on if required.

To view other status conditions on the VFD the controller must be placed in the **VIEW** mode.

4.2.2.1.   View Mode Operation

To enter **VIEW** hold the **NORMAL** key. The VFD will change to display the structure control number.

To exit to run mode hold the **NORMAL** key. The VFD returns to temperature and humidity display.

VIEW operation is similar to hand held terminal operation except that there is no access for set point changes

- To advance between groups (Status, Log, Set Points) press **ON**

- Within groups, to advance between families (e.g. Inputs, Controls etc.) press **OFF**

- Within a Family to move between data lines press **UP**, **DOWN**.

4.2.3.   Test Mode

MANUAL TEST and **AUTOMATIC TEST**, can be used to activate control equipment during start-up or servicing of the structure. In both modes, the 14 Control Status indicators retain their normal functions, while the remaining alarm and mode indicators become indicators of which control device is selected for test activation.

- **MANUAL TEST** should be used when more than one control device is to be operated concurrently or when only selected devices are to be activated.

- **AUTOMATIC TEST** should be used when sequential activation of each of the control devices is required, such as during customer acceptance or routine inspection.
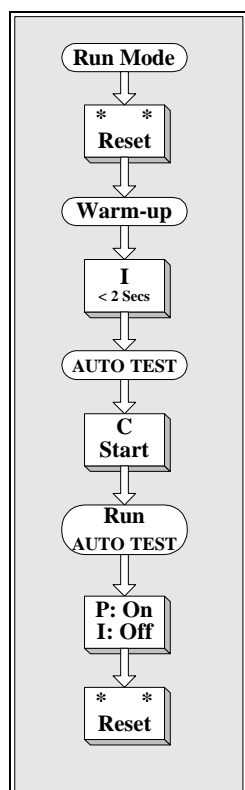
4.2.3.1.   Manual Test

To run **MANUAL TEST**:

1. Press both Reset keys concurrently, followed immediately by the Up key. The **INHIBIT** indicator will then blink at 2 blinks per second, and the remaining mode indicators will be on to indicate that the controller is ready to run **MANUAL** Test.

2. Press the **DOWN** key. The top Alarm Status light will turn on and the **INHIBIT** light will continue to blink. The Test Mode is now active, and any control device can be selected for activation.

3. Use the **UP** and **DOWN** keys to advance the status indicator to select the required control device. When the selection is correct press the **ON** key to activate the device.

   - To activate multiple control devices, leave the first one on, advance the selection to other devices and press **ON** for each additional selection.

   - When the blinking **INHIBIT** indicator is the only active LED in the left column, the Auxiliary 2 control device is selected and can be manually turned on or off.

   - When the Red Indicator LED is selected (**NORMAL** LED is on) the devices which will be activated, by pressing **ON**, will be all the alarm relays in the Model 2495.

   - When the Air Damper LED is selected, in addition to turning on the damper relay output, the controller will change the Analog Output from 2 VDC to 10 VDC.

4. To turn control devices off, move the selection to the required device and press **OFF**.

5. When the tests are complete, press both Reset keys concurrently to reset the controller. The controller will first enter warm-up mode and then return to **NORMAL**.
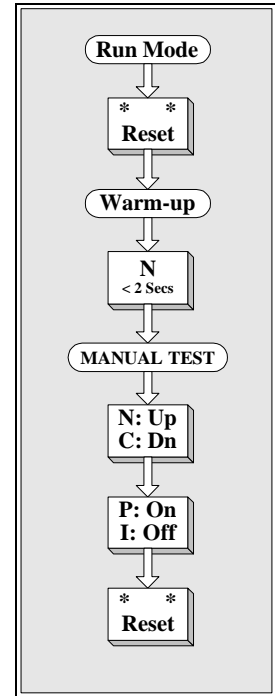
4.2.3.2.   Automatic Test

To run AUTOMATIC Test:

```
┌──────────────┐
│  Run Mode    │
│      ↓       │
│   *    *     │
│   Reset      │
│      ↓       │
│  Warm-up     │
│      ↓       │
│     I        │
│  < 2 Secs    │
│      ↓       │
│  AUTO TEST   │
│      ↓       │
│     C        │
│   Start      │
│      ↓       │
│    Run       │
│  AUTO TEST   │
│      ↓       │
│  P: On       │
│  I: Off      │
│      ↓       │
│   *    *     │
│   Reset      │
└──────────────┘
```

1. Press both RESET keys concurrently, followed immediately by the I key. The INHIBIT indicator will then blink at 2 blinks per second, and the remaining Mode indicators will turn on and off sequentially indicating that the controller is ready to run AUTOMATIC Test.

2. Press the **DOWN** key. The top Alarm Status light and the top control device will turn on simultaneously indicating the current AUTOMATIC Test step. After a pre-set period, the test will advance down to the next indicator and control device. AUTOMATIC Test will continue sequentially, device by device, until interrupted.

3. To interrupt the test, press the **DOWN** key again. The test will stop at the current step.

4. To resume the test, press the **DOWN** key, and the automatic sequence will restart at the next control device..

5. When the tests are complete, press both RESET keys concurrently to reset the controller. The controller will first enter warm-up mode and then return to NORMAL.

4.2.4.   Sensor Maintenance Mode

4.2.4.1.   Calibrate

Periodic calibration of gas sensors is required to assure accurate and reliable operation. The manufacturer recommends calibration every six months. This section provides a summary of the controller's operation during CALIBRATE. Refer to Chapter 5, Calibration, for the complete calibration procedure.

```
┌──────────────┐
│  Run Mode    │
│      ↓       │
│     C        │
│   Press      │
│      ↓       │
│  COMFORT     │
│      ↓       │
│     C        │
│   Hold       │
│      ↓       │
│  CALIBRATE   │
│      ↓       │
│     C        │
│   Hold       │
│      ↓       │
│  MAPPING     │
└──────────────┘
```

There are three phases to the calibration process—start calibration, apply calibration gas, and end calibration. Calibration is started by first selecting COMFORT (press C) and then by selecting CALIBRATE (hold C).

The controller takes calibration readings from all the gas detection sensors while calibration gas is being applied, and then it automatically stores this information in its memory. The calibration gas is an accurate mixture of all the gases needed to calibrate all the gas detection sensors. The calibration data will not be lost should power ever be removed from the controller. Operator actions and controller responses and indications during each phase of calibration are described in detail in Chapter 5.
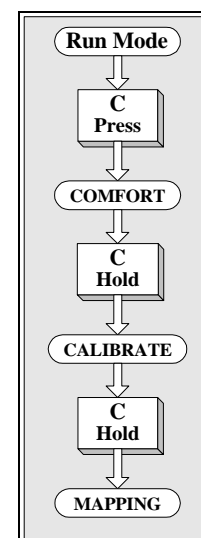
4.2.4.2.   Sensor Mapping

Sensor Mapping allows the controller to determine what operating gas sensors have been installed and, in the case of the carbon monoxide sensor, to determine whether an electrochemical or solid state CO sensor is installed. The main purpose for this functional mode is to enable (i.e., turn on or map in) another sensor when a new one is added. It can also be used to disable (i.e., turn off or map out) a sensor that has been removed, to temporarily disable a failed sensor, and to re-enable a replacement sensor after a failed sensor was temporarily mapped out.

To start **MAPPING**:

1. Press C key to initiate **COMFORT**.

2. Hold C key to initiate **CALIBRATE.**

3. Hold C key again to initiate **MAPPING**.

In Sensor Mapping, the controller will check all four gas sensor inputs.

- All installed and working sensors will be enabled.

- All removed or failed sensors will be disabled.

- Mapped date will be stored in controller memory.

Sensor Mapping runs for 10 seconds and then the controller automatically returns to **COMFORT**. During the 10-second sensor mapping, the four Mode LEDs will be Off, and the Alarm Status LEDs corresponding to any enabled, working sensors will be On. None of the four function keys will operate in Sensor Mapping.

- If the enabled sensor in the CO socket is a solid state type, the CO LED will blink rapidly during the 10-second Sensor Mapping

- If any new sensors are found and enabled during Sensor Mapping, a 5-minute warm up period for the new sensors will start after the Mapping function is completed. The corresponding Alarm Status LEDs for the new sensors on the front panel will blink (at 2 blinks per second) during this warm-up period. Newly enabled sensors will use default calibration values stored in the controller until they are calibrated.

4.2.5.   Other Operation

4.2.5.1.   Warm-up

Warm-up is automatically started any time power is applied to the controller or when the controller is reset. Warm-up is a five-minute period that allows the gas sensors to stabilize. After five minutes, the controller automatically returns to **NORMAL**.

To indicate that the warm-up is in progress the alarm indicator lights on the front panel will turn on and off in a vertical (walk) sequence. The walking sequence stops when the warm-up period is completed and the controller enters **NORMAL**.
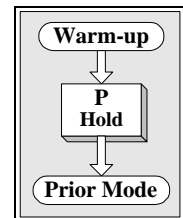
The warm up period can be stopped by pressing the **PURGE** key for five seconds, or until the **NORMAL** Mode LED turns on.

4.2.5.2.   Door Open Switch Operation

The structure's door open switch is an input to the Environment Controller. Transitions of the door switch are used, in conjunction with other inputs, to determine whether the structure is occupied or not. Opening the door causes the system to automatically select **COMFORT** and **PURGE** (see ¶4.2.1.2 and 4.2.1.3).

A structure will be considered occupied when the door has been opened or any Mode key has been pressed. A structure will be considered unoccupied if no function key is pressed for 6 minutes after the door has been closed.

The Environment Controller starts a door closure sequence when the structure's door is closed. During the first three minutes the buzzer will beep once every ten seconds. At the end of three minutes the main lights will turn off and the emergency light will turn on. The emergency light will remain on for another three minutes. This sequence will not start, however, if the controller is in Calibration, Sensor Mapping or Smoke Alarm. Also, if any key is pressed during the 6-minute door closure sequence, the structure will be considered occupied, and the sequence will be interrupted.

If door is closed during Calibration, the door close sequence will not start. If the calibration is successfully completed or is manually aborted, the structure is considered occupied. If calibration is timed out the system will start door close sequence.

4.2.5.3.   Reset

When both RESET keys are pressed concurrently, and released, the controller will Reset and begin a warm-up cycle. Immediately after the Reset keys have been released all four Mode LEDs turn on for a two second period which allows for test modes to be initiated.
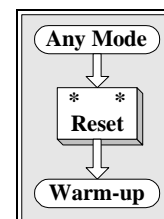
4.3.   LED Indicators

A general description of the LED indicators is provided in 4.1.1 and in discussions of various operational modes. This section summarizes the indicators and their functions.

4.3.1.   Mode Indicators

Table 4-2 summarizes operation of the LEDs during run mode.

INDICATOR	COLOR	NORMAL	COMFORT	PURGE	INHIBIT
NORMAL	Green	On*	Off	Off	Off
COMFORT	Amber	Off	On*	Off	Off
PURGE	Red	Off	Off	On*	Off
INHIBIT	Red	Off	Off	Off	On*
* When LED is on, it blinks slowly to provide positive indication that the processor is operating.					
Table 4-2 **Mode LED Indicators - Run Mode**					

Table 4-3 summarizes operation of the LEDs during special operational modes.

INDICATOR	COLOR	CALIBRATE	MAP	MANUAL TEST	AUTO TEST
NORMAL	Green	Off	Off	Off	Cycle
COMFORT	Amber	Flash*	Off	Off	Cycle
PURGE	Red	Off	Off	Off	Cycle
INHIBIT	Red	Off	Off	Flash	Flash
* Flash rate is two times per second.					
Table 4-3 **Mode LED Indicators - Special Modes**					

4.3.2.   Alarm Status Indicators

Table 4-4 summarizes the meaning of each Alarm Status LED during run mode and during special operation modes.

INDICATOR	COLOR	RUN MODE	CALIBRATE	MAP	TEST
Pump Run	Red	Sump Pump over 3 minutes	n/a	n/a	A/C 1 selected
High Water	Red	High Water Detected	n/a	n/a	A/C 2 selected
High Humidity	Red	High Humidity Alarm	n/a	n/a	Heater selected
High Temperature	Red	High temperature Alarm	n/a	n/a	Blower selected
Vent Sail	Red	Air flow not detected	n/a	n/a	Air Damper selected
Smoke	Red	Smoke Alarm	n/a	n/a	Dehumidifier selected
Combustible	Red	Solid: Gas Alarm Slow Blink: Sensor Fail	Active [1]	Active [2]	Sump Pump selected
Carbon Monoxide	Red	Solid: Gas Alarm Slow Blink: Sensor Fail	Active [1]	Active [2]	Main Lights selected
Oxygen	Red	Solid: Gas Alarm Slow Blink: Sensor Fail	Active [1]	Active [2]	Emergency Light selected
Hydrogen Sulfide	Red	Solid: Gas Alarm Slow Blink: Sensor Fail	Active [1]	Active [2]	Green Indicator selected
NORMAL	Green	Slow Blink: NORMAL Mode	Off	Off	Red Indicator selected
COMFORT	Amber	Slow Blink: COMFORT Mode	Blink	Off	DC Fan selected
PURGE	Red	Slow Blink: PURGE Mode	Off	Off	Auxiliary 1 selected
INHIBIT	Red	Slow Blink: INHIBIT Mode	Off	Off	Auxiliary 2 selected

Note: 1   1.   Off before applying calibration gas if a sensor is failed, disabled, or not installed.
             2.   On before applying calibration gas for installed, working sensors.
             3.   Blinking (2/second) while calibration gas is being applied for installed, working sensors.
             4.   Off after gas is removed for working sensors.
             5.   Blinking (rapidly)–for CO and H2S sensors only–before applying gas when there is background gas present.

Note: 2   1.   Off if sensor is failed, disabled, or not installed.
             2.   On for 10 seconds for installed, working sensors.
             3.   Blinking (rapidly) for 10 seconds–for solid state CO sensor only–for installed, working sensor.
             4.   Blinking (2/second) for 5 minutes after Mapping for newly enabled sensors.

Table 4-4
Alarm Status Indicators

4.3.3. Control Status Indicators

Table 4-5 summarizes the Control Status Indicators and their functions:

INDICATOR	COLOR	CONTROL FUNCTION
A/C 1	Amber	On if internal temperature exceeds set point. Lead/Lag logic determines which A/C is turned On first. Off during smoke alarm or inhibit mode
A/C 2	Amber	On if internal temperature exceeds set point. Lead/Lag logic determines which A/C is turned On first. Off during smoke alarm or inhibit mode
Heater	Amber	On when temperature drops low minimum NORMAL or COMFORT set point. Off during smoke alarm or inhibit mode
Blower	Amber	On continuously if Dynamic Damper Control Blower cycles On periodically when structure is occupied in Static Damper Control. Blower also turns On when cooling mode conditions are met in Static Damper Control. Off during smoke alarm or inhibit mode
Air Damper	Amber	Damper opens when cooling mode conditions are met and blower is on. Off during smoke alarm or inhibit mode
Dehumidifier	Amber	Dehumidifier turns On when humidity exceeds set point (default 85% RH) Special Case: If internal relative humidity sensor fails, the high humidity LED on the front panel will be on 0.5 seconds in every 3 seconds. The high humidity alarm relay will be On. Dehumidifier will be Off
Sump Pump	Amber	Sump Pump is turned On when water level rises above the "Pump On" (high) level. Sump Pump is turned Off when water level drops below the "Pump Off" (low) level.
Main Light	Amber	Main lights are On whenever the structure is occupied. Main lights turn Off three minutes into the exit routine.
Emergency Lights	Amber	Emergency lights are On when the structure is occupied and there is no AC power. Emergency lights are On for three minutes after the main lights turn Off during the exit routine.
Green Indicator	Amber	Green Indicator is On when the structure is safe to enter and the door is open or the structure is occupied.
Red Indicator	Amber	Red Indicator is On during entry procedure purge and at any time a gas or smoke alarm is On.
DC Fan	Amber	DC Fan is turned On when AC power is lost or when any gas alarm occurs.
Auxiliary 1	Amber	Special functions for custom applications
Auxiliary 2	Amber	Special functions for custom applications
Audible Alarm	n/a	Steady for 20 seconds when door is opened. Steady during gas alarm Pulsing if vent sail alarm occurs Mixed steady 5 seconds, pulse 5 seconds if both gas alarm and vent sail alarm occur. Pulse 10 seconds during first 3 minutes of exit routine Press "I" to acknowledge audible alarm

<div align="center">

Table 4-5
Control Status Indicators

</div>

4.4.   Vacuum Fluorescent Display (Option)

The optional two line, forty character vacuum fluorescent display can be factory installed on the front cover of the Environment Controller. The display functions are as follows:

- During normal occupied operation the display indicates the internal temperature and relative humidity.

- During the door close sequence, and for three minutes after the door close sequence has been completed the display reads "Press C turn on Lights".

- During unoccupied operation the display is turned off.

- The display can be used to interrogate other status conditions by following the View Mode instructions in Sections 4.2.2.1 and 8.4.

4.5.   Other Controller Operations

Various timers, alarm values and set points and special functions can be individually configured via the serial interface, using the set point menus. The factory default values of each set point are listed in the display of serial interface screens in Section 8.4.5 of this manual.

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5.   Calibration

5.1.   Calibration Overview

Periodic calibration of the environment controller's gas detection sensors is recommended to assure accurate and reliable operation. This procedure is a simple three step process:

- Start calibration mode by using the push-buttons on the controller front panel (Gas Alarm LEDs on solid).

- Apply calibration gases to the sensors for three minutes (Gas Alarm LEDs blinking).

- Verify successful calibration by watching the LED's on the front panel (Gas Alarm LEDs turn off).

Calibration gas is supplied in a single mixture containing all the necessary component gases in cylinders which fit the Sierra Monitor Model 1200-26 calibrator or the higher capacity Model 1250-00 calibrator.

5.2.   Calibration Procedure

5.2.1.   Calibration Keyboard Process

1. PURGE the structure for two minutes to insure that there is no background gas or alarm.

2. Press COMFORT key to insure the controller is in COMFORT Mode.

3. Press and hold the COMFORT key for 5 seconds until the Gas Alarm LEDs turn on. The controller turns on only the LEDs corresponding to mapped gas sensors.

    - The COMFORT LED will blink at 2 blinks per second to indicate that system is in the calibration mode.

    - Calibration cannot be started under the following circumstances:

        System is in warm up mode.
        Any sensor is in warm up mode.
        All enabled sensors failed.
        Any gas alarm is present.

    - During calibration mode, gas alarms are not active. Also, all other alarms, except smoke alarm, are active.

    - The LEDs of any disabled sensors or enabled but failed sensors will be off during calibration. After calibration is completed, the LEDs of any failed sensors will blink again.
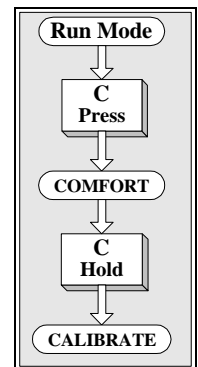
5.2.2.   Calibration Sensor Process

1. Prepare the gas calibration equipment according to its instruction manual.

2. Open the slotted sensor cover located at the top of the controller by turning each of the captive screws a half turn counter clockwise and then lifting the cover to the vertical position. The gas sensor slots from left to right are: Combustible, Carbon Monoxide, Oxygen and Hydrogen Sulfide. The fifth slot is the temperature and humidity sensor assembly which does not require periodic calibration.

**Figure 5-1
Model 2450
Sensor Cover Open View**

3. If a multi-port calibration adapter is used, place it over the group of sensors and allow the slotted cover to drop into position as a retainer. If a single cavity calibration adapter is used place it over each sensor in turn and repeat the following steps for each sensor.

4. Connect the gas delivery tube to the calibration adapter to begin the flow of gas.

5. Watch for each of the gas sensor LEDs to change from solid to flashing. This signifies that the sensor is functioning properly.

6. Maintain the gas flow for three minutes, then discontinue the gas flow and remove the calibration adapter.

7. The sensor LEDs should turn off within 2 minutes as the sensor signals return to the zero level. Calibration is then complete and the slotted cover can be closed and secured.
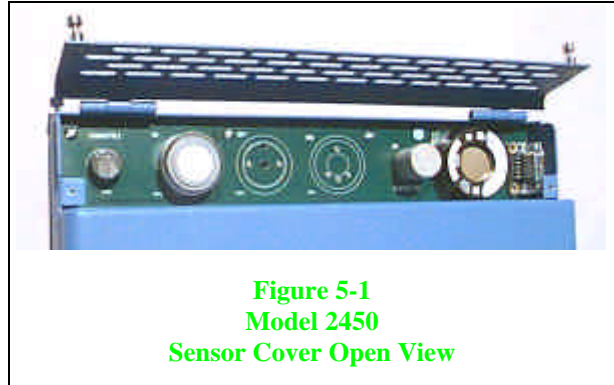
5.2.3.   Calibration Notes:

- If any sensor does not flash during the calibration period, the sensor should be replaced and the new sensor must be calibrated.

- If any key is pressed during calibration, the system will abort Calibration Mode and return to COMFORT Mode. The old calibration values will be used for the uncalibrated sensors.

- If any sensor has received enough gas to calibrate before the calibration is aborted, the 5-minute warm-up (recovery) period will start after calibration is aborted.

- If CO or H_2S electrochemical gas sensor senses more than 5 PPM of either CO or H_2S gas at the beginning of calibration, its corresponding LED will blink very fast (about 7 Hz) to indicate the background gas is too high to calibrate. If clean air is used to purge the sensor and background gas cleared while system is still in the calibration mode, the LED will return to solid indicating that the sensor is ready to calibrate.

- Calibration will be terminated if no sensor signal is higher than threshold within 15 minutes. This includes:

    1) No sensor signal is higher than its threshold after calibration mode has run for 15 minutes,

    2) One or more sensors' calibration is complete and the other sensors do not sense gas for 15 minutes.

- Gas alarms are not generated during gas sensor calibration.

- If any alarm, except smoke alarm, occurs during gas sensor calibration, the alarm LED and alarm relay will be on, red indicator will be on, and calibration will continue. The alarm conditions include: pump run, high water, high humidity, high temperature, vent sail.

6.   Maintenance & Service

6.1.   General Requirements

The following are the manufacturer's recommendations for periodic maintenance of the Model 2450 Environment Controller:

1   Calibration: Combustible, Carbon Monoxide, Oxygen and Hydrogen Sulfide, sensors require calibration every six months

2   Dust & Dirt Control: When calibration is performed the sensors should be checked visually to determine if dust or dirt build up needs to be removed. This cleaning should be done with dry instruments such as compressed air, cloth wipes or whisk broom.

6.2.   Sensors

Sensor replacement is required at any time a sensor trouble is indicated by a flashing Gas Alarm Status LED beside the specific sensor. Replacement is also required if the sensor fails to calibrate correctly. To replace a sensor:

1.   Open the sensor cover panel by loosening the wing screws on either side of the cover.

2.   Lift the sensor out of the sockets by pulling it gently away from the PCB assembly.

3.   Install a replacement sensor into the same socket.

4.   Turn on the sensor using the sensor mapping function described in Section 4.2.4.2

5.   Calibrate the sensor following the instructions in Section 05

6.3.   Troubleshooting

Trouble shooting recommendations can be obtained by calling Sierra Monitor Corporation at 1 800 727 4377. Sierra Monitor offers technical support including computer connection to the remote structure for trouble analysis.

6.4.   Controller Removal

If it is necessary to replace the Model 2450 controller:

1.   Make provision for temporary lighting in the structure before disabling the controller.

2.   Remove power from the control panel.

3.   Open the control panel door and remove three ribbon cables from the back of the controller.

4.   Remove the ground tie from the back of the controller.

5.   Remove four small nuts on the cabinet door and lift the controller off the front of the door.

6.   Reverse the procedure to install replacement controller.

6.5.   Interface Module Removal

If it is necessary to remove the Interface Module:

1.   Make provision for temporary lighting in the structure before disabling the controller.

2.   Remove power from the control panel.

3.   Open the control panel door and confirm that all wiring connections to the Interface Module are identified for re-installation.

4.   Remove -48 VDC power by disconnecting at the Alarm Connection Module or at another safe location upstream from the Interface Module.

5.   Remove all wiring from Interface Module terminals and move the wires clear of the PCB assembly.

6.   Locate and remove four screws which hold the black Interface Module mounting plate to the control panel cabinet.

7.   Lift the Interface Module out of the cabinet.

8.   Reverse the procedure to install the replacement Interface Module.

7.   Serial Interfaces

Model 2450 controllers are designed for convenient external interface via either direct or modem personal computer (PC) connection or via a hand held terminal. The controller automatically recognizes the method of communication at the time of any connection.

7.1.   PC Connections

7.1.1.   Modem

For remote connection via personal computer, a telephone line must be connected to the Model 2450 controller in the remote structure. The phone line can be permanently connected via the Model 2495 Alarm Connection Module, or temporarily connected via the "Line" jack on the side of the controller.

To initiate the remote connection:

1. Connect a telephone line to the PC's modem per the modem's user manual.
2. Use a terminal emulation program (such as Windows - Terminal) and configure the following settings: Baud Rate 2400, Data Bits: 8, Stop Bits: 1, Parity: None, Flow Control Xon/Xoff.
3. Select Terminal Emulation: VT-100.
4. Input the correct telephone number and dial the number.
5. When the two modems connect a message will be display on the terminal "Connect 2400".
6. After a pause of up to 30 seconds, the controller main menu will be displayed.
7. Follow instructions in Section 8.4.2 to use the menu items.
8. To disconnect use the terminal program's "Hang-Up" command.

7.1.2.   Direct

To connect a laptop computer directly to the controller:

1. Connect a serial cable with a DB-9 male connector to the serial port on the side of the controller.
2. Connect the other end of the cable to a COM port on the computer. Generally computer's COM-1 port requires a DB-9 female connector on the cable.
3. Open a terminal emulation program and enable COM-1.
4. The controller main menu will appear on the computer terminal screen.
5. Follow instructions in 8.4.2 to use the menu items.
6. To disconnect use the terminal program's "Disconnect" command, or remove the serial cable from the controller.

7.2.   Hand Held

A specially configured hand held terminal can be used to process inquiries by pressing labeled keys on the terminal. To connect the terminal to the controller:

1. Connect a serial cable with a DB-9 male connector to the serial port on the side of the controller.
2. Connect the other end of the cable to the hand held terminal.
3. The welcome menu will display on the terminal.
4. Follow instructions in Section 8.4.3 to use the menu items.

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8.   Appendices

8.1.   Appendix A: Model 2450/2490/2495 Specifications

Power: 120V (50/60 Hz) as the primary and/or -48V (20-66 VDC) as the backup
                       5 Watts nominal

Microprocessor: Motorola 68HCII with watchdog timer
                       Memory: 2.5 Kbytes EEPROM, 64K bytes EPROM, Real Time Clock with 2 day backup by a supercapacitor
                       Clock Speed: 8 MHz

Modem: Hayes Compatible 2400 Baud

Software: Supports any terminal communication program via modem or direct serial connection. Over 60 programmable set points and two level access code.

Environmental:
Temperature   Operating Range
                       4° to 122^oF (-20° to 50°C)
                       Storage Range
                       -40° to 122°F (-40° to 50°C)
Humidity   0 - 95% RH

Front Panel
Standard   Integral control panel with 6 keys and 28 LEDs. The 6 keys select the run mode: NORMAL, COMFORT, PURGE, INHIBIT and the reset function
Optional   Vacuum fluorescent alphanumeric display (2 rows x 20 characters)

Malfunction Protection   Automatically turns on blower, air damper red indication and malfunction alarm if system malfunctions or power is lost.

Control Features   Front panel selection of operating modes: Run, View, Test, Sensor Maintenance. Hand Held Terminal for viewing data or changing set points.

Sensors
  Combustible Gas
    Range   5,000 ppm (10% LEL)
    Sensor type   Solid-state metal-oxide semiconductor
    Sensor life   Over five years
    Set points   Occupied 2,500 ppm
                                      Unoccupied 5,000 ppm
    Response   < 30 seconds to 90% FS
  Carbon Monoxide
    Range   100 ppm
    Sensor type   Electrochemical
    Sensor life   Over 3 years
    Set points   Occupied 35 ppm
                                      Unoccupied 100 ppm
    Response   < 30 seconds to 90% FS
  Oxygen
    Range   25% by volume
    Sensor type   Electrochemical
    Sensor life   2 years
    Set points   Occupied 19.5%
                                      Unoccupied 16.5%
    Response   < 30 seconds to 90% FS
  Hydrogen Sulfide
    Range   100 ppm
    Sensor type   Electrochemical
    Sensor life   Over 3 years
    Set points   Occupied 10 ppm
                                      Unoccupied 20 ppm
    Response   < 30 seconds to 90% FS
  Temperature
    Range 0° to 221°F (-15° to 105°C)
    Sensor type   Solid-state
    Sensor life   Over ten years
    Accuracy $\pm$ 1oF (0.5oC)
  Humidity
    Range   0-100% Relative Humidity (RH)
    Sensor type   Solid-state
    Sensor life   Over ten years
    Accuracy $\pm$ 5% Relative Humidity

Inputs

Integral   (Model 2450)
                     Temperature
                     Humidity
                     Combustible Gas
                     Carbon Monoxide
                     Oxygen
                     Hydrogen Sulfide

External   (Terminals on the Model 2490,
                     controls in 2450.)

 Digital   Intrusion
                     Door Open
                     AC Failure
                     Smoke Alarm
                     Duct Sail Switch
                     High Water Alarm
                     Pump On Level Switch
                     Pump Off Level Switch
                     Spares (Qty 9)
                          Total Digital Points: 17

 Analog   (Optional sensors available)
                     External Temperature
                     Internal Temperature #1
                     Internal Temperature #2
                     External Relative Humidity
                     0-10 VDC Spare
                     4-20 mA Spare (Optional)
                          Total Analog Points: 6

Outputs

Alarms   (Alarm outputs are controlled by Model
                     2450, relays are located on Model
                     2495.)
                     SPST (Form A), 0.5 Amp, 60 VDC or
                     30 VRMS(AC), Rated for 20 Million
                     operations at 10V, 4mA load
                     Pump Run
                     High Water
                     High Humidity
                     High Temperature
                     Vent Sail
                     Smoke
                     Combustible Gas
                     Carbon Monoxide
                     Oxygen
                     Hydrogen Sulfide
                     AC Power Fail
                     Intrusion
                     Malfunction
                     Gas Detection Trouble
                     Common Motor Current Alarm
                     Spare (2)
                          Total Alarm Points: 17

Controls   Control outputs are controlled by Model
                     2450, the relays are also located on the
                     Model 2450. Connection terminals are on
                     the Model 2490
                     SPST (Form A), 0.5 Amp, 60 VDC or
                     30 VRMS(AC), Normally open contacts.
                     One end of all contacts connected to
                     common 24 VAC. Rated for 20 Million
                     operations at 10V, 4mA load
                     Air Conditioner #1
                     Air Conditioner #2
                     Heater
                     Blower
                     Air Damper
                     Dehumidifier
                     Sump Pump
                     Main Lights
                     Emergency Light
                     Green Indicator
                     Red Indicator
                     DC Fan (48V)
                     Spares (Qty 2)
                     Additional Dry Contacts:
                     Air Conditioner #1
                     Heater
                          Total Control Points: 14

Analog Output   One available, 4-20 mA, or 0-20
                     mA, or 0-10V, Loop resistance
                     400 ohm

Audible Output   Buzzer, variable alarm tone

Auxiliary Power   +12 VDC output for remote smoke
Output   detector.

Mechanical

<u>Model 2450</u>

Enclosure	NEMA-1 with hinged sensor cover panel
Mounting	Installs on door of electrical wiring enclosure
Connections	3 each 37 pin "D" connectors
Dimensions	11.25 x 8.75 x 2.0 inches (WxHxD) (28.6 x 22.2 x 5.1 cm)
Weight	3.2 lbs (2.3 Kg)

<u>Model 2490</u>

Enclosure	Enclosure by user
Connections	2 each 37 pin "D" connectors Screws terminals for sensor inputs and controls
Mounting	Supplied on mounting plate
Dimensions	13.0 x 9.0 inches (WxH) (33.0 x 22.9 cm)
Weight	4.2 lbs (1.9 Kg)

<u>Model 2495</u>

Enclosure	NEMA 1
Mounting	Internal Mounting holes for panel assembly
Connections	1 each 37 pin "D" connector Screw terminals for alarms, 48 VDC supply and phone line
Dimensions	8.0 x 8.0 x 2.0 inches (WxHxD) (20.5 x 20.5 x 5.0 cm)
Weight	1.4 lbs (0.63 kg)

8.2.   Appendix B: Limited Warranty

SIERRA MONITOR CORPORATION warrants its environment controller products to be free from defects in workmanship or material under normal use and service for two years after date of shipment. SMC will repair or replace, without charge, any equipment found to be defective during the warranty period. Final determination of the nature and responsibility for defective or damaged equipment will be made by SMC personnel.

All warranties thereunder are contingent upon proper use in the application for which the product was intended and do not cover products which have been modified or repaired without SMC approval or which have been subjected to accident, improper maintenance, installation or application, or on which original identification marks have been removed or altered. This Limited Warranty also will not apply to interconnecting cables or wires, consumables (i.e. calibration gases, batteries), nor to any damage resulting from battery leakage.

In all cases SMC's responsibility and liability under this warranty shall be limited to the cost of the equipment. The purchaser must obtain shipping instructions for the prepaid return of any item under this warranty provision and compliance with such instruction shall be a condition of this warranty.

Except for the express warranty stated above, SMC disclaims all warranties with regard to the products sold hereunder including all implied warranties of merchantability and fitness and the express warranties stated herein are in lieu of all obligations or liabilities on the part of SMC for damages including but not limited to consequential damages arising out of/or in connection with the use or performance of the product.

8.3.   Appendix C. Product Numbering

8.3.1.   Model Numbers

Table 8-1 lists the model numbers for the major components of the Environmental Control system:

MODEL NUMBER	DESCRIPTION
2450-20	Environment Controller with software license for CEV, CEC and Hut, with no gas sensors.
2450-21	Same as 2450-20, with combustible gas sensor
2450-22	Same as 2450-21 with carbon monoxide sensor
2450-23	Same as 2450-22 with oxygen sensor
2450-24	Same as 2450-23 with hydrogen sulfide sensor
2450-40	Same as 2450-20 with vacuum fluorescent display option
2450-41	Same as 2450-21 with vacuum fluorescent display option
2450-42	Same as 2450-22 with vacuum fluorescent display option
2450-43	Same as 2450-23 with vacuum fluorescent display option
2450-44	Same as 2450-24 with vacuum fluorescent display option
2490-20	Interface Module with 110 VAC and -48 VDC power supplies
2495-10	Alarm Connection Module

Table 8-1
Major Component Model Numbers

8.3.2.   Options

Table 8-2 lists model numbers for Environment Controller options.

MODEL NUMBER	DESCRIPTION
1200-26	Calibration Kit
1290-03	Cylinder, calibration gas, methane 5,000 ppm
1290-08	Cylinder, calibration gas carbon monoxide 25 ppm
1250-02	Calibration Kit, multi gas, high capacity
1260-50	Cylinder, calibration gas mixture methane 5,000 ppm, carbon monoxide 25 ppm
1260-51	Cylinder, calibration gas mixture, four gases.
2401-50	Remote Indicator Box
2404-50	Smoke Detector - 12 VDC
2480-00	Hand Held Terminal w/ Cable
SPK22087	Temperature Sensor, External (15' cable)

Table 8-2
Optional Item Model Numbers

8.3.3. Spare Parts

Table 8-3 lists spare and replacement parts available from Sierra Monitor Corporation.

MODEL NUMBER	DESCRIPTION
SPK33003	Sensor, Combustible Gas
SPK33030	Sensor, Carbon Monoxide
SPK33044	Sensor, Oxygen
SPK33041	Sensor, Hydrogen Sulfide
SPK22031	Sensor Assembly, Temperature, Humidity
SPK22082	Cable, Ribbon 37 lead, Alarm Connector
SPK22084	Cable, Ribbon 37 lead, Interface Connector
SPK25011	Cable, Serial DB9, for Hand Held Terminal
Table 8-3 **Spare Part Model Numbers**	

8.4.   Appendix E - Data Interface Screens

8.4.1.   Description

Status conditions, data logs and set points can be viewed via computer terminal, hand held terminal or the optional vacuum fluorescent digital display on the controller. Set points can be changed via computer terminal or hand held terminal.

A similar menu/data structure is used for each of the methods of communication. The data structure is described in 8.4.2, Computer Terminal Instructions.

8.4.2.   Computer Terminal Instructions

Instructions for making initial connection via computer are provided in Section 7.1.1 (modem) and 7.1.2 (direct). Once a connection is made, the controller sends a menu to the computer. The menu screen is the first example shown in Section 8.4.5, below. See also, Figure 8.1.

Note that:

- The header of the menu screen lists the controller tag number (or location), the controller software version number, and the current date and time at the controller location.

- Each line of the menu is prefixed by an alpha symbol (A through N).

- The lines are "grouped" by Status, Log and Set Point. The terminology for Hand Held Terminal and VFD Display refers to these "Groups".

- Within each Group there are several "Families". For example The Status Group has Alarm, Control and Input Families.

```
            WELCOME TERMINAL OPERATOR
             CEV 123 MAIN, NOTOWN, SC
               CONTROL #: 2450-CC-VR
                 TIME:  01/01/96 12:00

                     MAIN MENU
A     STATUS              - ALARMS
B     STATUS              - CONTROLS
C     STATUS              - INPUTS
D     STATUS              - POWER SUPPLY & GAS
E     LOG                 - ENVIRONMENTAL
F     LOG                 - ALARMS
G     LOG                 - RUN TIMES
H     SET POINTS          - TIMERS
I     SET POINTS          - TEMPERATURE & HUMIDITY
J     SET POINTS          - VENTILATION
K     SET POINTS          - GAS MONITOR
L     SET POINTS          - CONFIGURATION
M     MOTOR CURRENT TEST
N     SECURITY
```

Figure 8-1
Computer Terminal Main Menu

To display the "Line Item" data for any family press the corresponding alpha key on the computer keyboard. Each of the line item displays are reproduced in Section 8.4.5, below.

To return to the main menu at any time, press the space bar, or escape key. To change line item displays without returning to the main menu, press the new alpha key.

Although Set Points can be viewed by any user, they are protected from change unless the user is authorized via a security code. Security codes for set point changes are described below.

8.4.2.1.   Security PIN Codes

1. There are two levels of security. The level one master code allows level two PIN codes to be established. Each PIN code is a four digit number.

```
N) SECURITY
 1 Change Master PIN
 2 Change Operator PIN
```

2. To establish user codes on a new controller, Press "N". The controller will prompt "1" to Change Master PIN, 2 to Change Operator PIN. Select "1" and follow the prompts to input a four digit Master PIN

3. To establish an operator PIN, Press "N" and input the Master PIN. ". The controller will prompt "1" to Change Master PIN, 2 to Change Operator PIN. Select "2" and follow the prompts to input a four digit Operator PIN

4. After PIN numbers have been established, either the Master or the Operator PIN can be used to authorized set point changes.

8.4.2.2.   Set Point Changes

Set point changes can only be made when a Master or Operator PIN number authorization has been input.

When set point changes are authorized, each of the Set Point Group data screen will display with line numbers for each data line.

To make set point changes:

1. Input PIN code.

2. Press the alpha key corresponding to the required set point family.

3. Input the number of the set point to be changed, press Enter.

4. The terminal will display the current value and prompt for the new value.

5. Input the new value, press Enter.

6. The terminal will display the new value and ask for a Yes/No validation.

7. Press the Y key to validate, N key to reject the new value.

8. The terminal will return to the set point family display screen with the new value.

8.4.3.   Hand Held Terminal Instructions

Instructions for connection of the Hand Held Terminal (HHT) are provided in Section 7.2.

When the HHT is properly connected, it will display the same data as the header of the computer terminal main menu. To access data displays:

1. Press the labeled "Group" key. The display will indicate the alpha number of the first family in the group, and the corresponding Group indicator LED on the HHT will light.

2. Use the left and right arrow keys on the HHT to move between families within groups.

Figure 8-2
Computer Terminal Display
Hand Held Terminal

3. Use the up and down arrows on the HHT to move between data lines within a family.

4. To change set points press the Set Point key, followed by the right arrow until the "N" menu is displayed. Then follow the same instructions as 8.4.2.2.

8.4.4.   View Mode Instructions

All data lines can be viewed on the Vacuum Fluorescent Display (VFD) by using
View Mode. Instructions for entering View Mode are provided in 4.2.2.1. View
operation is similar to HHT operation except that there is no access for set point
changes.

1. To advance between groups (Status, Log, Set Points) press On

2. Within groups, to advance between families (e.g. Inputs, Controls etc.) press
    Off

3. Within a Family to move between data lines press Up, DOWN.

Figure 8-3
VFD Display on Controller

8.4.5. Computer Screens

WELCOME TERMINAL OPERATOR
-----------CEV 123 MAIN, NOTOWN, SC ------------
CONTROL #: 2450-CC-VR
TIME: 01/01/96 12:00

MAIN MENU

A	STATUS	- ALARMS
B	STATUS	- CONTROLS
C	STATUS	- INPUTS
D	STATUS	- POWER SUPPLY & GAS
E	LOG	- ENVIRONMENTAL
F	LOG	- ALARMS
G	LOG	- RUN TIMES
H	SET POINTS	- TIMERS
I	SET POINTS - TEMPERATURE & HUMIDITY	
J	SET POINTS	- VENTILATION
K	SET POINTS	- GAS MONITOR
L	SET POINTS	- CONFIGURATION
M	MOTOR CURRENT TEST	
N	SECURITY	

A STATUS	- ALARMS
Pump Run	OFF
High Water	OFF
High Humidity	OFF
High Temperature	OFF
Vent Sail	OFF
Smoke	OFF
Combustible Gas	OFF
Carbon Monoxide	OFF
Oxygen	OFF
Hydrogen Sulfide	OFF
Intrusion	OFF
AC Power Fail	OFF
Gas Detection Trouble	OFF
Motor Current Alarm	OFF

B STATUS	- CONTROLS
A/C 1	OFF
A/C 2	OFF
Heater	OFF
Blower	OFF
Air Damper	OFF
Dehumidifier	OFF
Sump Pump	OFF
Main Lights	OFF
Emergency Light	OFF
Green Indicator	OFF
Red Indicator	OFF
DC Fan (48V)	OFF

C STATUS	- INPUTS
Internal Temperature	75 ^{o}F
Relative Humidity	50 %
External Temperature	85 ^{o}F
Smoke Alarm	OFF
Intrusion Switch	OFF
Door Open	OFF
Duct Sail Switch	OFF
High Water	OFF
Pump On Level Switch	OFF
Pump Off Level Switch	OFF
AC Failure	OFF
A/C Compressor 1	OFF
A/C Compressor 2	OFF
A/C Condenser Fan	OFF
Pump Over Run	OFF
Blower Motor	OFF

D STATUS	POWER SUPPLIES & GAS
AC to 5.5 VDC	5.5 VDC
48 VDC to 5.3 VDC	5.3 VDC
+12 VDC	12.0 VDC
Combustible Gas	% FS
Carbon Monoxide	00 PPM
Oxygen	20.9 %
Hydrogen Sulfide	00 PPM

E LOG		- ENVIRONMENTAL
Log Reset Date/Time		12/31/95 09:00
Highest Internal Temperature	95 ^{o}F	3/15/96 16:15
Lowest Internal Temperature	65 ^{o}F	1/05/96 01:25
Highest External Temperature	95 ^{o}F	3/15/96 16:15
Lowest External Temperature	65 ^{o}F	1/05/96 01:25
Highest Relative Humidity	92%	3/15/96 10:35
Lowest Relative Humidity	40%	3/15/96 10:35

F LOG	- ALARMS
00 - 08/13 10:57	System reset= On
01 - 08/13 9:12	Vent sail alarm= Off
02 - 08/13 9:11	Vent sail alarm= On
03 - 08/13 8:17	System reset= On
04 - 08/01 11:13	Vent sail alarm=Off

G LOG	- RUN TIMES
Run Times Reset Date/Time	12/31/95 10:00
Run Time A/C 1 (hh:mm)	145:20
Run Time A/C 2	144:55
Run Time Heater	14:25
Run Time Blower	2,127:15
Run Time DC Fan	0:19
Run Time Sump Pump	1:03
Run Time Dehumidifier	12:10
Run Time Main Light	4:18
Run Time Emergency Light	00:24

H	SET POINT	- TIMERS
1	Sensor Warm-up Time	5 mins
2	Comfort Mode Span	120 mins
3	Purge Mode Span	60 mins
4	Inhibit Mode Span	30 mins
5	Test Mode Span	120 Mins
6	Auto Test Step Time	10 secs
7	Door Close Main Lights On	180 secs
8	Emergency Light On	180 secs
9	Pump Run Alarm Delay	180 secs
10	High Water Alarm Delay	10 secs
11	Inhibit Horn Span	5 mins
12	Vent Sail Alarm Delay	10 secs
13	Gas Alarm Blower Off Delay	30 Secs

I	SET POINT- TEMPERATURE & HUMIDITY	
1	A/C 1 On Delay	120 secs
2	A/C 2 On Delay	180 secs
3	A/C Lead/Lag Temperature Differential	2 °F
4	A/C **NORMAL** Temperature Set Point	95 °F
5	A/C **COMFORT** Temperature Set Point	72 °F
6	Heater **NORMAL** Temperature Set Point	60 °F
7	Heater **COMFORT** Temperature Set Point	63 °F
8	High Temperature Alarm Set Point	125 °F
9	High Temperature Full Vent Set Point	120 °F
10	Temperature Set Point Differential	5 °F
11	Dehumidifier On Set Point	55 %RH
12	Dehumidifier Off Set Point	50 %RH
13	High Humidity Alarm Set Point	85 %RH

J	SET POINT	- VENTILATION
	Air Damper Control Method	Static
	Static Control Method	
	Cooling Mode Criteria	
1	Internal Temperature (above)	85 °F
2	External Temperature (below)	80 °F
3	Internal Humidity (below)	75%
	Occupied Ventilation	
4	Cycle Time	15 mins
5	Blower/Damper Run Time/Cycle	60 secs
	Dynamic Control Method	
6	Internal Temperature Minimum	68 °F
7	External Temperature Minimum	40 °F
8	Internal Humidity Maximum	75%
9	Temperature Differential	5 °F
10	Damper Position Update Rate	10 secs

K	SET POINT	- GAS MONITOR
1	Combustible Enabled	Yes
2	Calibration Concentration	5,000 PPM
3	Vent Control Set Point	2,500 PPM
4	Alarm Set Point	5,000 PPM
5	Carbon Monoxide (CO) Enabled	Yes
6	Calibration Concentration	35 PPM
7	Vent Control Set Point	35 PPM
8	Alarm Set Point	100 PPM
9	Oxygen Enabled	No
10	Calibration Concentration	18.0 %
11	Vent Control Set Point	19.5 %
12	Alarm Set Point	16.5 %
13	Hydrogen Sulfide (H_2S) Enabled	No
14	Calibration Concentration	10 PPM
15	Vent Control Set Point	10 PPM
16	Alarm Set Point	20 PPM

L	SET POINT	- CONFIGURATION
1	Forced Input Enabled	No
2	Auto Comfort Mode	Yes
3	Red/Green Status Light Always On	Yes
4	Suppress Low CO Logic	No
5	A/C 2 Enabled	Yes
6	DC Fan Enabled	Yes
7	A/C Compressor 1 Monitor Enabled	No
8	A/C Compressor 2 Monitor Enabled	No
9	A/C Condenser Fan Motor Enabled	No
10	Sump Pump Over Run Monitor Enabled	No
11	Blower Motor Monitor Enabled	No
12	Location	Sierra Monitor Factory
13	Time	17:01
14	Date	08/21
15	Calibrate Temperature Sensor	1/1/96
16	Calibrate Relative Humidity Sensor	1/1/96

M	MOTOR CURRENT TEST	
1	A/C 1 Test	Passed
2	A/C 2 Test	Passed
3	Sump Pump Test	Passed
4	Blower Motor Test	Passed
5	Auto Test	Passed

N	SECURITY	
	Enter PIN Number	####

LIST OF FIGURES

LIST OF TABLES